FINAL

Annotated Bibliography and Literature Review Summary for the Compost Reconnaissance Study Contract 43A0172 Task Order 51

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Annotated Bibliography and Literature Review Summary for the Compost Reconnaissance Study

TABLE OF CONTENTS

1. Introduction 1

2. Background 2

3. Benefits and Risks of Compost Use 4

4. Runoff Reduction and Erosion Control 7

5. Compost and LID 11

6. Application Rates and Methods 13

7. Professional Interviews 19

8. Summary 20

9. References 21

Attachment 1 Interview Questionnaires

Over 12 million tons of compostable materials were land filled in California in 2003 (Caltrans 2008). The burying of these potentially useful materials not only consumes diminishing landfill space, but also fails to realize the benefits and value. Compostable organics can improve soil structure and fertility, infiltration, reduce runoff, promote healthy vegetation, reduce erosion, and, as a result, improve water quality.

The federal Clean Water Act (CWA) Section 401 requires that water quality standards (water quality criteria for sediments, pathogens, nutrients, metals, etc.; designated uses, and anti-degradation policy) not be exceeded. There has been concern that the use of compost as a best management practice (BMP) could lead to the exceedance of water quality standards or a Water Quality Objective (WQO). As such, and although specifications for a variety of compost application methods and types have been developed by Caltrans, there is still reluctance by both Caltrans and the State Water Resources Control Board (SWRCB) to further develop details and approve specifications for the use of compost as a standard Caltrans BMP.

This draft annotated bibliography summarizes a literature review conducted as defined in the Scope of Work for Task Order No. 51 – Statewide Compost Reconnaissance Study. The primary goal of the study was to identify the risks and benefits of compost use as a standard Caltrans BMP, address concerns on compost use stemming from WQOs, identify the most appropriate and effective application methods and rates, and research the use of compost to achieve long-term low impact development (LID) goals outlined by the SWRCB.

The purpose of this Annotated Bibliography and Literature Review Summary (Summary) is to summarize the most current compost application technologies, the results of recent compost-application-related studies, and how these studies apply to erosion and sediment control measures and stormwater treatment for transportation projects.

The results of the literature review are organized as follows:

- Section 2 presents a background summary.
- Section 3 provides risk and benefit analyses, focusing on the impact of compost on water quality and the environment in the short vs. longterm.
- Section 4 addresses the effectiveness of compost as a sediment and erosion control measure, as well as its impact on soil quality, vegetation enhancement, and runoff and infiltration.
- Section 5 summarizes the role of compost in LID.
- Section 6 provides a summary of application rates and methods outlined in the literature reviewed.
- Section 7 provides a summary of the professional interviews

A summary of findings is provided in Section 8, and a full list of references for the literature review is included in Section 9.

The U.S. Environmental Protection Agency (EPA), the SWRCB, and each Regional Water Quality Control Board (RWQCB) have responsibility for the coordination and control of water quality. Each of the nine RWQCBs makes critical water quality decisions for its region, including setting standards, issuing waste discharge requirements, determining compliance with those requirements, and taking appropriate enforcement actions.

The CWA prohibits discharges of stormwater containing pollutants except in compliance with a National Pollutant Discharge Elimination System (NPDES) permit. In California, the EPA has delegated administration of the NPDES program to the SWRCB and the RWQCBs. On July 15, 1999, the SWRCB issued Caltrans a statewide permit (Order No. 99-06-DWQ) (Permit) that regulates all stormwater discharges from Caltrans owned MS4s, maintenance facilities, and construction activities. The SWRCB and RWQCBs are responsible for enforcement of the Permit. Caltrans' Stormwater Management Plan (SWMP) describes the procedures and practices used to reduce or eliminate the discharge of pollutants to storm drainage systems and receiving waters (Caltrans 2003) and meet the conditions of the Permit.

The Permit requires Caltrans to reduce or prevent pollutants in stormwater discharges through the development and implementation of BMPs to either the Maximum Extent Practicable (MEP) or the Best Available Technology economically achievable/Best Conventional Pollutant Control Technology (BAT/BCT), whichever is applicable. Stormwater discharges must also be in compliance with applicable local, state, and federal water quality standards or objectives (e.g., Statewide Water Quality Control Plan, the California Toxics Rule, the National Toxics Rule, or the applicable RWQCB's Water Quality Control Plan).

On January 20, 2005, the SWRCB adopted sustainability as a core value for all California Water Boards' activities and programs, and directed California RWQCB staff to consider LID (to address sustainability as a core value) in all future policies, guidelines, and regulatory actions (RESOLUTION NO. 2005-0006). In order to address this core value and work toward sustainability through LID, Caltrans would like to support the argument of using compost as a standard BMP for future highway construction projects.

In 2005, the California Integrated Waste Management Board (CIWMB) partnered with Caltrans, the University of California, Riverside (UCR) Extension, the Association of Compost Producers (ACP), the United States Compost Council (USCC), UC Cooperative Extension, Filtrexx, and Soil Control Laboratories to identify and address the barriers preventing Caltrans from maximizing its use of compost. Working together, these various stakeholders developed a suite of compost specifications (Caltrans 2008). The barrier to standard use of these specifications, however, has been in the cost-effectiveness of the outlined application rates and methods, lack of guidance for quality control (including water quality impact and agronomic analyses), and continued concern from the SWRCB and RWQCBs for water quality standard exceedance (particularly pertaining to biosolids and pathogens).

In addition to meeting the standards set by the SWRCB and RWQCBs, Caltrans needs to consider the competing objectives of the SWRCB/RWQCBs and the CIWMB, who is a major proponent of using compost as a BMP. Some of the RWQCBs have expressed being open to compost applications, while other RWQCBs and the SWRCB have lingering concerns. This document will address some of these concerns through the summary of reviewed pertinent literature; however, further conclusions and analyses will be made throughout the scope of this Task Order. The end goal of these analyses is to develop tools and information on the benefits and risks of compost use as a BMP, identify the most appropriate and effective application methods and rates, outline the role of compost in LID, revise Caltrans compost specifications, and facilitate the use of compost as a standard BMP.

Composting is the controlled biological process of decomposition and recycling of organic material into a humus rich soil amendment known as compost. Compost has a variety of uses and is known to improve soil quality and productivity as well as prevent and control erosion, thereby improving the quality of water runoff. Mixed organic materials (e.g., manure, yard trimmings, food waste, biosolids) must go through a controlled heat process before they can be used as high quality, biologically stable and mature compost (otherwise it is just mulch, manure, or byproduct).

The process of composting takes these raw materials and stabilizes them under controlled conditions. Stabilizing the material takes the nutrients, such as nitrogen, and ties them up in the compost's organic matter. The nutrients are slowly released over time, increasing the opportunity for up-take by plants and reducing downstream water pollution problems. For that reason composting is recognized as a BMP by the EPA's Non Point Source Program (USEPA, 2003)

3.1 United States Composting Council. *The Field Guide to Compost Use.* 1996.

In 'The Field Guide to Compost Use' the United States Composting Council provides reasons for compost's benefits. Specifically, compost:

1. Improves the soil structure, porosity, and bulk density, thus creating a better plant root environment.
2. Increases infiltration and permeability of heavy soils, reducing erosion and runoff.
3. Improves water holding capacity in sandy soils, reducing water loss and leaching.
4. Supplies a variety of macro and micronutrients.
5. Controls or suppresses certain soil-borne plant pathogens and nematodes.
6. Supplies significant quantities of organic matter.
7. Improves cation exchange capacity (CEC) of soils, improving their ability to hold nutrients for plant use.
8. Supplies beneficial microorganisms to soils.
9. Improves and stabilizes soil pH.
10. Binds and degrades specific pollutants.

3.2 Rissem, Mark and Faucette Britt, *Compost Utilization for Erosion Control.* Cooperative Extension Service, The University of Georgia College of Agricultural and Environmental Sciences. 2001.

Researchers at the University of Georgia also promote the benefits of compost and the positive impacts it has on water quality.

Specifically, compost controls erosion, and improves the quality of water runoff, by:

1. Increasing water infiltration into the soil surface.
2. Reducing runoff and soil particle transport in runoff.
3. Increasing plant growth and soil cover.
4. Reducing soil particle dislodging.
5. Increasing water holding capacity of soil, which reduces runoff.
6. Buffering soil pH which can increase vegetation establishment and growth.
7. Alleviating soil compaction by increasing soil structure.
8. Facilitating establishment of new vegetation directly in compost.

When used as a filter berm, compost:

1. Reduces sediment from reaching surface water by acting as a filter.
2. Reduces fertilizers, chemicals, metals, and other pollutants from reaching surface waters in stormwater runoff.
3. Can be used as a waste reduction tool. (i.e., keeps used silt fences out of the landfill and uses recycled organic materials).

3.3 Salisbury, Sandy "WSDOT Experience using compost on Roadside Applications." Washington Department of Transportation. October 11, 2006.

The goal of this study by the Washington State Department of Transportation (WA DOT) was to assess how compost may reduce pollutants in the water runoff thereby improving water quality. A series of 4-inch compost blankets, called Compost Amended Vegetated Filter Strips (CAVFS), with a minimum of 40 percent organic matter were installed at drainage plots adjacent to highways with shoulders. Through the use of French drains below the CAVFS, the researchers were able to capture contaminants in the runoff. The strips with the compost amendment exhibited decreased flow volumes and flow rates as compared to filter strips without compost. The CAVFS were found to substantially reduce pollutant concentrations and loads in highway runoff for all pollutants except soluble phosphorus and dissolved copper in comparison to filter strips without a compost amendment.

In addition, over one year of monitoring, the researchers found three times the vegetative cover as compared to sites without compost amendments.

3.4 V. P. Claassen and J. L. Carey, "Regeneration of Nitrogen Fertility In Disturbed Soils Using Composts," *Compost Science & Utilization* 12, no. 2 (2004): 145-152.

The increased nutrient level in compost has the positive benefit of increasing soil quality and enhanced vegetation establishment; however, as illustrated by the WA DOT study, increased levels of nitrogen and phosphorus in compost can result in greater levels of these nutrients in water runoff.

The researchers evaluated the sediment and nutrient runoff for a series of compost applications. These applications included the inclusion of mature or immature compost applied directly to the ground surface or through incorporation. To test the impact of infiltration, the compost blankets were applied to tilled and untilled surfaces. The purpose of the study was to use field plots to develop on-the-ground practices to better manage erosion and maximize sediment source control on ski area properties.

The treatments that produced the lowest NO3- runoff were those with no compost added, or those with a compost blanket over compost tilled into the soil. The highest losses of NO3- came from compost applications to plots with reduced infiltration (lack of tillage, or no compost incorporated to maintain pores). Ammonium losses were highest from plots having a compost blanket application over soil with reduced infiltration, either from lack of tillage, or tillage without organics incorporated into the soil, or from bare soils with no composts added at all. The immature compost had about 20 percent of the ammonium loss as the mature compost in a paired set of treatments. The presence of grass cover or improved infiltration was associated with reduced ammonium losses. Phosphorus losses were also lowest with grass cover or improved infiltration although statistical differences were not detected at the studied location and rain year. The highest losses occurred with compost blankets over bare soil or soils with reduced infiltration.

The three treatments with the lowest sediment or nutrient losses were the treatments that had grass growth or that had enhanced infiltration (compost mulch over compost incorporated into the soil (MCT)). The poorest performing treatments (highest overall scores and greatest losses of sediment and nutrients) were those treatments that had a missing treatment component, such as no tillage or no mulch cover, or tillage without compost incorporation to maintain open pore structure, allowing the soil to recompact and lose infiltration.

Once pollutants, whether sediment or specific contaminants, are picked up by water, it is difficult to keep them from moving downstream. Therefore, practices that prevent erosion are much more effective at preventing pollution than those that attempt to clean water after it has already gained a load of pollutants. Many studies have shown that compost can be highly effective for reducing and preventing erosion on an exposed slope. While preventing erosion is always the first choice, it is not always possible, and compost has also proved to be effective at filtering stormwater pollutants originating from construction sites.

4.1 United States Composting Commission. "Compost for Stormwater Management". 2008.

This fact sheet describes how the highest risk of erosion and sedimentation is while a project is under construction, especially in the beginning phases while substantial earth-moving is occurring. Soil loss from construction sites can be 200 times that of forest lands, and 10 to 20 times that of agricultural lands (GA S&W Cons. Comm, 2002).

The fact sheet describes how many studies have shown that compost can be highly effective for reducing and preventing erosion on an exposed slope. Unlike most other stormwater BMPs, compost has significant water holding capacity, so that low-to-medium intensity and duration rain events may produce no runoff at all (Persyn et al. 2004). Those that do produce runoff produce less, take longer before runoff starts, and longer to reach peak flow (Glanville et al. 2003). Using compost of low nutrient value has the added benefit of releasing less phosphorus and nitrogen than hydroseeding, hydromulching, and seeded straw mulches, all common forms of erosion control (Faucette et al. 2005).

While minimizing erosion is always the first choice, it is not always sufficient, and compost has also proved to be effective at filtering stormwater pollutants originating from construction sites. Both freestanding berms made of compost and compost "socks" (long tubes constructed of open weave or knit fabric and filled with composted mulch) have surpassed the traditional practices of silt fence and hay bales at reducing the pollutant loads of construction stormwater. Unlike the traditional practices, which work primarily as temporary stormwater detention devices allowing solids to settle out of the water, the berms and socks act as both detention and as true filters, removing not only the settleable solids but a significant percent of suspended solids as well as nutrients and hydrocarbons.

Berms have the advantages of a wide "footprint" with intimate soil contact that all but eliminates undercutting and very low disposal and cleanup costs, but have the disadvantages of lack of visibility in active construction zones and poor performance in direct flows. Socks have the advantages of visibility and ability to function in concentrated flows but slightly higher disposal costs. For compost filter media, the mean total solids removal was 92 percent, mean suspended solids removal was 30 percent, mean turbidity reduction was 24 percent, and mean motor oil removal rate was 89 percent (Faucette et al. 2006b). Moreover, the researchers found that by adding polymers to the

filter media, removal efficiencies could be improved, sometimes dramatically. For example, turbidity reduction was increased from 21 percent to more than 77 percent, and soluble phosphorus removal increased from 6 percent to 93 percent.

This study found that the compost blanket treatments averaged 2.75 times more vegetative cover than hydroseed after 3 months. After one year, the compost and hydroseed treatments had similar cover percentages, but the hydroseed had significantly greater weed biomass than compost and a greater ratio of weed biomass relative to Bermuda grass biomass (Faucette et al, 2006).

4.2 "Compost Use for State Highway Applications." Composting Council Research and Education Foundation (CCREF).

This booklet is a summary of different studies described below:

Portland Metro research documented that compost filter berms (83 percent reduction) can be twice as effective as silt fences (39 percent reduction) in reducing total solids (TS) in runoff.

4.3 Glanville, Thomas D., Tom L. Richard and Russel. A Persyn. "Final Report: Impacts of Compost Blankets on Erosion Control, Revegetation, and Water Quality at Highway Construction Sites in Iowa." Iowa State University. April 2003.

This comprehensive study found that rill runoff from conventional topsoil treatments contained solids concentrations that were 3.5 times higher than in rill runoff from compost treatments. There were no significant differences; however, in the solids concentrations measured in rill runoff from composts and compacted embankment soils (control). These results indicate that compost treatments are as vulnerable to rill erosion as compacted embankment conditions, but do represent some improvement over conventional topsoil treated applications.

4.4 V. P. Claassen and J. L. Carey, "Regeneration of Nitrogen Fertility in Disturbed Soils Using Composts," *Compost Science & Utilization* 12, no. 2 (2004): 145-152.

This study was performed on two types of compost sources: (1) yard waste lawn clippings and chipped brush, and (2) biosolids/yard waste (cocompost material). The study discusses compost as a resource for replacement of organic matter (specifically nitrogen) in topsoil on disturbed sites, in terms of using yard waste compost as a soil amendment.

The study concludes that nitrogen release rates varied widely between source materials during the initial portions of the study, with cocomposts having much greater release rates than the yard waste composts. Steady, long-term N releases were observed from composts throughout the second half of the study and were expected to continue on. In the study composts were shown to provide a suitable replacement source of slowly available nitrogen for plant establishment on drastically disturbed, low nutrient soils.

4.5 "Compost Use for State Highway Applications." Composting Council Research and Education Foundation (CCREF)

In research performed by Dr. William Sopper of Pennsylvania State University, compost (and biosolids) were applied to a gravely site, possessing a low pH and organic matter content, and contaminated with zinc. Within fifteen months of the application, the hillside was covered by a combination of orchard grass, tall fescue, and crown vetch. Newly planted trees showed a survival rate of over 70 percent. In this example, the compost not only supplied plant nutrition and moderated soil pH, but also established a nitrogen and organic matter cycle in the soil and immobilized heavy metals, by both reducing their leachability and absorption by plants.

4.6 Connecticut Department of Transportation (ConnDOT) Roadside Study

Compost used in this project was derived from spent mushroom substrate. Several species of trees and shrubs were planted. Using compost to amend planting soil was very successful according to ConnDOT and the Connecticut Department of Environmental Protection (CTDEP). None of the plants planted with compost needed replacement (i.e., the mortality rate was zero percent), compared to a mortality rate of approximately 40 percent in the standard ConnDOT control plants. Another inspection conducted in September 1998 confirmed that the survival rate for the compost amended plants was still 100 percent.

With the exception of survival rate, there were no apparent differences in the condition between plants planted with compost and those planted without compost.

4.7 D.E. Rider, M.J. Curtis and V. P. Claassen, "Annual Sediment, Nitrogen, and Phosphorous Losses from Bare and Compost Amended Fill Slopes" *Draft Interim Report for Model Guided Specification for Using Compost and Mulch to Promote Establishment of Vegetation of and Improvement in Stormwater Quality RTA # 65A0182*

The objectives of this study were to compare compost treatments (screened and cured, unscreened and uncured), compost application methods (blanket, incorporated, or a combination of a blanket over an incorporated) in terms of total runoff volume, total suspended solids, and nutrient losses (total dissolved N, NH4-N, NO3-N, dissolved organic N, dissolved organic C, and total P) from 2:1 tilled or planed bare slopes on disturbed earth fill materials.

The study found that the type and production method of compost that is utilized (i.e., maturity, curing, feedstocks) greatly affects nutrient leaching potentials. The method of application (blanket or incorporation), and soil preparation (tilled or nontilled) influences the overall performance of compost treatments. Muzzi et al. (1997) found, however, that surface amendments alone were not adequate to stop erosion and that, in most cases, tilling the ground before mulch application produced the most effective erosion control and plant growth.

Results of the study showed that the highest sediment losses occurred from the bare planed soil, the bare tilled soil, and the compost mulch tilled into soil. These were treatments that were either bare or had only fine (< 3/4 inch) compost fibers that did not hold the soil well after tillage. The incorporation of compost into the soil may have increased sediment loss due to mechanical fracturing. No other treatments differed significantly in this experiment, but the lowest sediment losses were from grass-covered slopes or those with tillage and a mulch cover.

Compost not only helps prevent erosion immediately upon application, it also provides an effective substrate for seed growth, conserving moisture, suppressing weeds, and providing slow release nutrients to support the establishment of vegetation, thus providing long-term erosion control.

This chapter summarizes references reviewed that relate to low impact development (LID) practices utilizing compost. Implementation of effective LID practices is important for successful and sustainable stormwater management.

5.1 Horner, Richard R., "Investigation of the Feasibility and Benefits of Low-Impact Site Design Practices ("LID") for the San Diego Region". No Date.

This purpose of this study is to investigate the relative impact of three levels of stormwater treatment BMPs on certain water quality and water reuse factors: basic "treat-and-release" BMPs (e.g., drain inlet filters, CDS units), commonly used BMPs that expose runoff to soils and vegetation (e.g., extended-detention basins and biofiltration swales and filter strips), and LID practices. Low-impact methods reduce stormwater runoff and associated contaminants by source control, infiltrating into the soil or evaporating storm flows before they can enter surface receiving waters, treating flows remaining on the surface through contact with vegetation and soil, or a combination of these strategies. Soil-based LID practices often use soil enhancements such as compost, and thus improve upon the performance of more traditional basins and biofilters. The factors considered are runoff volume, pollutant loading, and the availability of water for infiltration or other reuse.

Developments implementing no post-construction BMPs, stormwater runoff volume, and pollutant loading are substantially increased and recharge rates are substantially decreased compared to predevelopment conditions. Second, developments implementing basic post-construction treatment BMPs achieve reduced pollutant loading compared to developments with no BMPs, but stormwater runoff volume and recharge rates are similar to developments with no BMPs. Third, developments implementing traditional basins and biofilters, and even LID post-construction BMPs, achieve significant reduction of pollutant loading and runoff volume as well as greatly enhanced recharge rates compared to both developments with no BMPs and developments with basic treatment BMPs.

This report shows LID techniques to be capable of regaining the groundwater recharge lost in development to a greater extent than conventional BMPs. At the same time LID techniques substantially preserve predevelopment hydrologic conditions and prevent most pollutant transport to receiving waters.

5.2 "Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption." Low Impact Development Center. December 2007.

This article discusses how California has already made steps toward a regulatory system that encourages better treatment performance and the application of LID. It goes on to describe how the SWRCB's recent emphasis on limiting hydromodification impacts (changes in a site's runoff and transport characteristics) from development will create the framework for broader adoption of LID.

In addition, the Porter-Cologne Act (commonly referred to as the California Water Code) allows the RWQBC's broad discretion to implement innovative natural resource

protection programs because it allows the regulation of any activity or factor that affects water quality and is not narrowly focused on end-of-pipe treatment.

5.3 United States Composting Commission Fact sheet, "Compost for Reducing Water Pollution". 2008.

This report discusses the use of compost in stormwater management describing how stormwater management falls into two divisions, construction and post-construction. Construction tends to have short-term impacts, while post-construction are longer term. The move to reduce the environmental impact of development is called LID. LID is defined as design and implementation of post-construction stormwater hydrology that mimics predevelopment patterns. LID management practices seek to reduce both peak flow rates and runoff volume by slowing flows and increasing filtration thereby decreasing pollutant loads entering water bodies. Incorporating compost into these practices can dramatically lower runoff volume due to improved water-holding capacity, healthy vegetation/biomass, and increased infiltration.

LID stormwater practices that include or benefit from the use of compost include:

Rain gardens and/or *bioretention systems* – Designed to treat onsite stormwater runoff, these BMPs are highly effective at removing pollutants and reducing the volume of stormwater entering the storm drain system. Sometimes called bioretention or biofiltration beds, they typically feature native plants, several inches of wood mulch, and a planting mix that includes 20to30 percent compost.

Vegetated roofs, or *green* roofs - Unlike metal or asphalt roofs that can contribute to thermal and chemical water pollution, green roofs can significantly reduce total stormwater runoff as well as improve the quality of the water. Mature compost is often included in the growing media component of a green roof. To meet the exacting specifications for the media, including weight, porosity, and stability, compost usually makes up 10 to15 percent of the total volume.

5.4 Puget Sound Action Team, "*Low Impact Development: Technical Guidance Manual For Puget Sound*" Washington State University Pierce County Extension. January 2005.

This manual provides recommendations for determining infiltration rates of soils in bioretention areas. It recommends test protocols, depending on the size of the contributing area, for the amount of compost to be amended into soil. The manual also provides guidance for adding mulch layers in bioretention areas. Specifically, it argues that bioretention areas can be designed with or without a mulch layer; however, there are advantages to providing a mulch application or a dense groundcover. Research indicates that most attenuation of heavy metals in bioretention cells occurs in the first 1 to 2 inches of the mulch layer. The manual also provides recommendations for the application rates and methods for compost and mulch.

The following references discussed below provided information regarding application rates and methods of compost for stormwater BMPs.

6.1 Alexander, Ron, "Standard Specs for Compost for Erosion/Sediment Control". Ron Alexander Associates. 2003.

The article covers compost produced from various organic by-products for use as filter berm and compost blankets for erosion and sediment control. The technique for filter berms described in the specification is primarily used for temporary erosion and sediment control applications, where perimeter controls are required or necessary. The technique for compost blankets described is appropriate for slopes up to a 2:1 grade, and should only be used in areas that have sheetflow drainage patterns (not areas that receive concentrated flows). The technique for compost blankets may be used for both temporary and permanent erosion and sediment control applications.

Test methods used in the specifications were provided in The Test Methods for the Examination of Compost and Composting (TMECC), Jointly published by the United States Department of Agriculture and the United States Composting Commission (2002 publishing as a part of the USDA National Resource Conservation Technical Bulletin Series).

6.2 M. Grismer et al., "Integrated monitoring and assessment of soil restoration treatments in the Lake Tahoe Basin," *Environmental Monitoring and Assessment* May 16, 2008.

In an effort to proactively address current and upcoming water quality regulations, Caltrans engaged in a 10 year program to develop, demonstrate, and monitor cutting edge erosion control techniques. The report summarizes monitoring results and presents recommendations. While many variations of full soil restoration treatments (e.g., compost with different variations of fine and coarse compost, wood chips, and tubbings) were found to reduce sediment by 2 to 32 times when compared to typical surface treatments such as Erosion Control Type D, a treatment of 25 percent coarse compost and 75 percent fine compost in particular is recommended: The report details the application rates and method along with recommendations on what should not be included in the compost amendment.

Of special value, the report contains a decision tree illustrating the recommended protocol based on nutrient value expectation, soil type, and amount of solar radiation. It is important to note that this study is specific to the Tahoe Basin, but the essential approach could be applied in a broader arena.

6.3 Glanville, Thomas D., Tom L. Richard and Russel. A Persyn. "Final Report: Impacts of Compost Blankets on Erosion Control, Revegetation, and Water Quality at Highway Construction Sites in Iowa." Iowa State University. April 2003.

The results of this study indicate that the depth of compost applications significantly affected runoff quantities, most likely as a result of increased pore volume associated with greater compost depths. Runoff from 5-cm (2-inch) applications was about 1.5 times the runoff from 10-cm applications (unvegetated conditions). Presence or absence of vegetation did not result in significant differences in runoff. Depth of application did not significantly affect rill or interrill erosion rates. Plots treated with 5-cm of compost performed about the same as those receiving 10-cm applications. Type of compost affected interrill erosion rates noticeably. Yard waste compost, the coarsest and most "mulch-like" of the three composts, averaged less than 1 percent of the interrill erosion produced by the more soil-like biosolids and bio-industrial composts.

6.4 "Compost Use for State Highway Applications". Composting Council Research and Education Foundation (CCREF). No Date.

This article also summarizes specifications used for all 50 states. The article summarizes all of the specifications into a table by:

- Soil incorporation compost specifications – compost used "in the soil"
- Soil mulching and erosion/sediment control specifications – compost used "in the soil"
- All specifications

Several case studies discussed in this document are summarized below.

6.4.1 Florida DOT Turf Establishment Study

Three composts typical of those that might be generally available were used in this project. One was made of biosolids and yard trimmings, the second with biosolids and municipal solid waste (MSW), and the third with yard trimmings only. Three roadside test sites were selected. At each test site, the upper 8 inches of road-shoulder soil was rototilled with a 6-foot-wide rototiller after compost application and broadcast seeded with the FDOT standard mixture of bahiagrass (80 percent) and bermudagrass (20 percent) at a rate of 200 kilograms/hectare. The areas were lightly mulched with straw after seeding, cut into the soil with a coulter, and the soil firmed with a rubber wheel.

Amendment of road-shoulder soil with composts improved grass seeding establishment and subsequent growth. Several application rates were tested; however, an application rate of 45 tons per acre was generally sufficient to improve establishment and persistence of utility turf. There were no adverse effects observed with applications up to 135

tons/acre. The amount of "plant available water" held by amended soil was greater than that held by unamended soil. Much of this increase was lost after about 6 months (with the exception of the 135 tons/acre application). This appeared to be due to the better vegetation growth and less erosion at one of the sites.

Compost application increased the fertility status of the soils as evidenced by the increases in concentration of plant nutrients like phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg), with biosolids composts adding more nutrients than yard trimmings composts. Concentrations of all nutrients increased with increasing compost application rates. Compost application also increased the concentrations of the micronutrients iron (Fe), zinc (Zn), copper (Cu), and manganese (Mn), but not to levels that would be harmful to plants. One year after compost was incorporated and seed planted on the road shoulder, vegetative cover remained greater for all plots that received compost than for those which had not. Vegetative cover was generally not improved significantly above the 45 tons/acre rate of compost amendment.

6.4.2 Idaho DOT Vegetation Reestablishment Study

Composts were used as a soil amendment and mulch in this project. Dairy manure compost was spread onto shallow slopes at a 20 cubic yard/acre rate and anchored to the surface with a cultivator. A formulated organic soil amendment product was hydro-applied on steeper slopes at a rate of 2,000 pounds/acre. The slopes were treated with both products in fall 2000. As of May 2001, good germination and early growth were observed; however, it has been a dry and hot spring in Idaho, and continued growth and vigor is dependent on rainfall.

6.4.3 The Texas Department of Transportation (TxDOT) Study

TxDOT recently completed a project in July 1999 using compost for revegetating a badly eroded and bare slope along a highway in Big Spring, Texas. The objective of this project was to demonstrate how the utilization of compost could effectively revegetate a barren slope.

The slope was treated with 100 cubic yards of a feedlot manure compost and further amended with wood chips for erosion control. The compost was produced from feedlot manure, cotton burrs, and yard trimming wood chips. The wood chips (3 inch minus screen size) were added to the compost to help resist wind erosion at the site. The mix ratio was 3 parts compost to 1 part wood chips (on a volume basis). The compost-wood chip mix was applied to the site with a Rexius blower truck to a depth of 3 inches overall and at a depth sufficient to fill in the erosion gullies on the site. The compost-chip mix covering the site successfully resisted a 2-inch heavy rainfall that occurred soon after application. An added benefit of the compost/chip mix was to retain moisture for longer periods, which was a benefit to grass germination. Two months after application, the site was heavily vegetated by a healthy, stable grass vegetation community.

The TxDOT found that compost applications of up to 3 inch blankets were required to re-establish grasses on drastically disturbed slopes. The TxDOT requires the compost particle sizes to be no more than 3 inches, with 70 percent being less than 2 inches. The compost must contain 40 to 60 percent organic content and no more than 5 mmohs cm-1 of soluble salts. This use of compost coupled with site-specific mixtures of wood chips or other mulches has allowed for successful revegetation on projects previously considered to be unrestorable.

6.4.4 Washington DOT Study

Composts made from recycled organic materials were used in new highway construction projects (slopes). Class A biosolids compost was used at two of the sites tested. WSDOT specifications for compost require that the material meet quality standards for pH, particle size, maturity, soluble salts, organic matter, and inerts. An additional requirement for one of the sites was that the composted biosolids have a carbon to nitrogen ratio of 35:1. The use of a high carbon ratio product was used to suppress weeds and to enhance long-term survival of woody vegetation.

Compost was blown with a pneumatic blower truck onto two-thirds of the slope. The project specification was for a 1-inch layer, but the contractor laid on a thicker cover because of the moisture content in the compost. The uncovered portion of the slope was used as a control. The compost was incorporated into the soil using hand labor, but only within the terraces; the rest of the area had compost applied to the surface.

Shortly after work was completed, erosion had occurred in the control section, but in the section treated with compost, no erosion was observed. Three months later, grass was established on all terraces; however, where the composted biosolids were applied, the annual ryegrass was thicker, greener, and withstanding drought conditions better than the control section.

6.5 "Compost Specifications: Caltrans Landscape Architecture," http://www.dot.ca.gov/hq/LandArch/policy/compost_specs.htm .

This specification describes procedures and requirements for incorporating compost onto slopes 4:1 or flatter. The compost producer must be fully permitted as specified under the California Integrated Waste Management Board (CIWMB), and/or applicable State and Local Agencies, and must be a participant in the United States Composting Council's Seal of Testing Assurance program.

Compost may be derived from any single material or mixture of any of the following feedstock materials:

1. Green material consisting of chipped, shredded, or ground vegetation; or clean processed recycled wood products
2. Biosolids

3. Manure
4. Mixed food waste

Compost must not be derived from mixed municipal solid waste and must be reasonably free of visible contaminants. Compost must not contain paint, petroleum products, pesticides, or any other chemical residues harmful to animal life or plant growth. Compost must not possess objectionable odors. Metal concentrations in compost must not exceed the maximum metal concentrations listed in Title 14, California Code of Regulations, Division 7, Chapter 3.1, Section 17868.2.

The specification gives a table of required physical and chemical properties of compost, including pH, soluble salts, moisture content, organic matter content, maturity, stability, particle size, passing of fecal coliform test, passing of salmonella test, and physical/man made contaminant content requirements.

6.6 Caltrans Compost Specifications, Erosion Control Type C

Erosion Control (Type C) work includes applying seed, fiber, stabilizing emulsion, straw, and compost to "fill" slopes. The seed, fiber, and stabilizing emulsion are typically mixed in a slurry with water and applied from a hose attached to a hydroseed truck. Compost can either be applied together with the other materials in the slurry, or it can be dry-applied as a separate step in the process. While a separate dry application of compost has a higher labor cost, the material cost of the bulk (dry) compost can be up to 1/10th the cost of the bagged compost required for hydroseed application.

6.7 Caltrans Compost Specifications, Erosion Control Type D

Erosion Control (Type D) work includes applying seed, fiber, stabilizing emulsion, and compost to "cut" or "fill" slopes. The seed, fiber, and stabilizing emulsion are typically mixed in a slurry with water and applied from a hose attached to a hydroseed truck. Compost can either be applied together with the other materials in the slurry, or it can be dry-applied as a separate step in the process. While a separate dry application of compost has a higher labor cost, the material cost of the dry compost can be up to 1/10th the cost of the bagged compost required for hydroseed application.

6.8 Caltrans Compost Specifications, Drill Seed

Drill seeding involves placing seed in the soil with a device similar to that used by farmers to plant agricultural crops. Placing the seed in the soil offers greater protection from the sun, wind, birds, and like items that inhibit seed germination. To help improve soil fertility, and reduce erosion by high winds and rainfall, this specification asks that a thin layer of compost and stabilizing emulsion be applied to the soil surface after the drill seeding work is complete.

6.9 Caltrans Compost Specifications, Compost Blanket

Compost blanket work involves placing a thin layer of coarse compost to an area and then applying the seed via hydroseeding or dry/hand application. If applied via

hydroseed, fiber and stabilizing emulsion are to be applied as well. The compost protects the seed from the elements promoting germination, provides nutrients to enrich the soil, and acts as a mulch reducing competition from annual weed species, reducing stormwater runoff and helping conserve soil moisture.

Compost application thickness is not specified. Seed may be either applied mechanically in a dry condition or with hydroseeding equipment. With hydroseed, a minimum of 525 pounds of fiber per acre must be mixed and applied with the seed. The fiber must be furnished and applied at no expense to the state. If seed is applied with hydroseeding equipment, it must be applied within 60 minutes after the seed has been added to the hydroseeder. Compost blanket must extend to the edge of retaining sidewalks, walls, curbs, dikes, paving, and to within 4 feet from the flow line of paved and unpaved drainage ditches.

6.10 Caltrans Compost Specifications, Soil Amendment

The soil amendment specification (similar to the other compost-related specifications) requires soil amendment used on Caltrans projects to be compost produced from the following feed stocks: green material, biosolids, manure, or mixed food waste and meet the environmental health standards of Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.

This specification does not go into detail regarding application methods/rates.

6.11 Caltrans Compost Specifications, Mulch

The mulch specification allows the designer to select and specify mulch from a list of materials including green material, tree bark, wood chips, and shredded bark and requires green material mulch be produced by a compost producer that belongs to the U.S. Composting Council (USCC) Seal of Testing Authority (STA) program, as well as compost materials in conformance with Title 14, California Code of Regulations, Division 7, Chapter 3.1, Article 7.

In addition to reviewing literature, a questionnaire was developed and used to interview individuals with expertise in storm water and landscape management. A total of eight professionals were contacted. Responses were received from eight individuals representing a broad spectrum of state transportation departments, university researchers, and private businesses. A list of responders is provided below. The questionnaires summarizing the information from each individual that responded are included as Attachment 2.

- Brian Larrimore, Californian Integrated Waste Management Board
- Dr. Britt Faucette, Filtrexx International
- David Crohn, University of Riverside, California
- Greg Balzer, Caltrans
- Kathleen Groody, Integrated Waste Board/EPA
- Michael Hogan, IERS, Inc.
- Sandy Salisbury, Washington State Department of Transportation
- Scott McCoy, KSS Consulting, LLC.

All respondents indicated that they have conducted research in the past regarding the use of compost in highway applications. Approximately half said that they are currently looking into future research opportunities. The respondents were almost universal in their support for the benefits of using compost. These benefits include increases infiltration, decreases runoff, decreases erosion, reduces pesticide use, reduces fertilizer use, reduces irrigation requirements, better for natives in comparison to hydroseeding since petrochemical fertilizers result in fast weed growth (weeds grow rapidly and outcompete natives), increases soil organic matter, improves cation exchange capacity of soils (retains nutrients for plant use), encourages production of beneficial microorganisms, and binds and degrades specific pollutants.

The risks of using compost include the release of nutrients, especially in the “first-flush” and the increase of pathogens in the runoff. Respondents found that although total nutrient load is decreased after a first rain, the initial release may be small, but concentrated. Depending on type of application, there may be no runoff except in extreme storm events. Dust problems can result unless applied properly. A majority of respondents would agree that plants are important, but soil edaphic factors are the critical consideration for erosion reduction. To reduce the risks of using compost, a tested quality control program is essential. Additionally, the correct product must be used for specific types of applications and it must be applied correctly.

Many references exist that present information on compost. Although the literature indicates the potential for increased nutrients in flows from compost treatments, there is substantial conclusion that compost benefits exceed potential limitations and no specific evidence on compost resulting in exceedances of WQO was identified in the literature reviewed. More detailed technical discussions on water quality, vegetation establishment, and LID, including quantitative information where available, will occur in subsequent technical memorandums.

V. P. Claassen and J. L. Carey, "Regeneration of Nitrogen Fertility In Disturbed Soils Using Composts," *Compost Science & Utilization* 12, no. 2 (2004): 145-152.

M. Grismer et al., "Integrated monitoring and assessment of soil restoration treatments in the Lake Tahoe Basin," *Environmental Monitoring and Assessment*. May 16, 2008.

Puget Sound Action Team, "*Low Impact Development: Technical Guidance Manual For Puget Sound*" Washington State University Pierce County Extension January 2005.

Low Impact Development Center "Review of Low Impact Development Policies: Removing Institutional Barriers to Adoption." December 2007.

United States Composting Commission Factsheet, "Compost for Stormwater Management" 2008.

United States Composting Commission Factsheet, "Compost for Reducing Water Pollution" 2008.

"Compost Specifications: Caltrans Landscape Architecture," http://www.dot.ca.gov/hq/LandArch/policy/compost_specs.htm .

California Dept. of Transportation and California Stormwater Management Program., *BMP retrofit pilot program* (Sacramento, CA: Division of Environmental Analysis, California Dept. of Transportation, 2004).

California Alpine Resort Environmental Coop "Sediment Handbook" 2005 for Sierra Business Council.

California Integrated Waste Management Board, "Compost Use for Landscapes and Environmental Enhancement" June 2007.

Matthew J. Curtis and Victor P. Claassen, "Annual Sediment, Nitrogen and Phosphorus Losses From Bare And Compost Amended Fill Slopes." Draft Interim report for RTA #65A0182.

Rider D.E., M.J. Curtis, V.P. Classen, "Literature Review: Compost Use for Erosion Control and Improved Stormwater Quality"

"Compost Use for State Highway Applications" Composting Council Research and Education Foundation (CCREF)

Salisbury, Sandy. "WSDOT Experience using compost on Roadside Applications". Washington Department of Transportation. October 11, 2006.

Horner, Richard R. "Investigation of the Feasibility and Benefits of Low-Impact Site Design Practices ("LID") for the San Diego Region"

Alexander, Ron. 2003. ”Standard Specs for Compost for Erosion/Sediment Control” Ron Alexander Associates.

Glanville, Thomas D., Richard, Tom L., and Persyn, Russel. A. “Final Report: Impacts of Compost Blankets on Erosion Control, Revegetation, and Water Quality at Highway Construction Sites in Iowa.” Iowa State University April 2003.

National Cooperative Highway Research Program. et al., *Evaluation of best management practices for highway runoff control.* (Washington, D.C.: Transportation Research Board, 2006).

Rider D.E., M.J. Curtis and V. P. Claassen, “Annual Sediment, Nitrogen, and Phosphorous Losses from Bare and Compost Amended Fill Slopes” *Draft Interim Report for Model Guided Specification for Using Compost and Mulch to Promote Establishment of Vegetation of and Improvement in Stormwater Quality RTA # 65A0182*

Rissem Mark and Faucette Britt, *Compost Utilization for Erosion Control* Cooperative Extension Service The University of Georgia College of Agricultural and Environmental Sciences. 2001.

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43A0172 - Task Order #51, Compost

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Interviewee Information:

Point of Contact:	Brian Larimore
Agency/Institution/Employer:	California Integrated Waste Management Board
Phone Number:	(916) 341-6579
Email Address:	BLarimore@ciwmb.ca.gov

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as in roadside vegetative recovery applications.
- The purpose of this review is to illustrate the potential impacts of compost use on water quality, vegetation re-establishment, and hydrograph modification. The CalTrans compost specification may be modified according to the results of this review.
- Our goal is to support (or reject) the notion that existing CalTrans specifications for compost application provide downstream and in-situ water quality benefits, boost the viability of vegetative recovery efforts, and promote sustainable, low-impact development.

Questions:

1. Has your department conducted research studies on compost or compost amendments?

   Yes

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

   Yes

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   Benefits: increased infiltration, decreased runoff, decreased erosion, reduced pesticide use, reduced fertilizer use, reduce irrigation requirements, better for natives in comparison to hydroseeding since petrochemical fertilizers result in fast weed growth (weeds grow rapidly and outcompete natives), increases soil organic matter, improves cation exchange capacity (CEC) of soils (retains nutrients for plant use), encourages production of beneficial microorganisms, reduces greenhoue gas production, binds and degrades specific pollutants (TSS, particulate metals, oil)
   Risks: Although total nutrient load is decreased, may see release upon first rain event

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4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

• Compost enriched bulk hydroseeding	Somewhat familiar
• Compost blanket application following drill seeding	Somewhat familiar
• Seed application over rough compost blanket	Somewhat familiar
• Seed application over incorporated compost	Somewhat familiar
• Compost as a general soil amendment (e.g. for backfilling around tree plantings)	Somewhat familiar
• Rough compost applied as mulch (composted to remove weed seeds, pathogens, etc.)	Somewhat familiar
• Other Please briefly describe application method:	See below

Biofiltration strips, bioswales, and drill seed

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

Plant seed must be placed at proper depth. For example, some seeds should be scattered on surface while others may do better at a shallow depth. Mulches may need to be reapplied every three years or so. Also, see answer to question #3.

6. Please add any additional comments.

Using electrical conductivity (EC) of composts in determining suitability for specific applications is problematic as it doesn't differentiate between "good salts" and "bad salts."

7. If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

Thank you for taking time to participate in this survey.

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Interviewee Information:

Point of Contact:	Dr. Britt Faucette, Ph.D., CPESC, LEED AP
Agency/Institution/Employer:	Filtrexx International
Phone Number:	678 592 7094
Email Address:	brittf@filtrexx.com

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as in roadside vegetative recovery applications.
- The purpose of this review is to illustrate the potential impacts of compost use on water quality, vegetation re-establishment, and hydrograph modification. The CalTrans compost specification may be modified according to the results of this review.
- Our goal is to support (or reject) the notion that existing CalTrans specifications for compost application provide downstream and in-situ water quality benefits, boost the viability of vegetative recovery efforts, and promote sustainable, low-impact development.

Questions:

1. Has your department conducted research studies on compost or compost amendments?

   Yes

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

   Yes

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   Benefits include: reduced runoff volume, runoff rate, runoff curve numbers, rational runoff coefficients, sediment loads, fine particulate loads, soluble pollutant loads, irrigation, and fertilizer use; increased soil quality, vegetation establishment and vegetation sustainability. These BMPs decentralize site stormwater management, assist in achieving natural site hydrology patterns and Low Impact Development (LID) design goals.
   Risks include: inadequate QA/QC program, specifications not based on scientific/peer reviewed research, improper installation and/or design.

4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

• Compost enriched bulk hydroseeding	Very Familiar. Only economically viable
• Compost blanket application following drill seeding	Very Familiar. Seed should be
• Seed application over rough compost blanket	See above
• Seed application over incorporated compost	See above. Compost
• Compost as a general soil amendment (e.g. for backfilling around tree plantings)	
• Rough compost applied as mulch (composted to remove weed seeds, pathogens, etc.)	Great very temporary erosion
• Other	compost socks

Please briefly describe application method:

Used effectively to remove sediment, fine particulates, and soluble pollutants from construction and post-construction stormwater management.

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

See Question/Answer #3.

6. Please add any additional comments.

Please review these peer reviewed/scientific publications on water quality impacts/ benefits, vegetation/soil impacts, and site hydrology and LID when using compost based BMPs.

17. Faucette B, C. Jordan, M. Risse, M. Cabrera, D. Coleman, L. West. 2005. Evaluation of Storm Water from Compost and Conventional Erosion Control Practices in Construction Activities. Journal of Soil and Water Conservation. 60:6: 288-297.

7. Faucette, L. Britt, Carl F. Jordan, L. Mark Risse, Miguel L. Cabrera, David C.

7. If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

Thank you for taking time to participate in this survey.

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Interviewee Information:

Point of Contact:	David Crohn
Agency/Institution/Employer:	University of California, Riverside
Phone Number:	951-827-3333
Email Address:	David.Crohn@ucr.edu

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as in roadside vegetative recovery applications.
- The purpose of this review is to illustrate the potential impacts of compost use on water quality, vegetation re-establishment, and hydrograph modification. The CalTrans compost specification may be modified according to the results of this review.
- Our goal is to support (or reject) the notion that existing CalTrans specifications for compost application provide downstream and in-situ water quality benefits, boost the viability of vegetative recovery efforts, and promote sustainable, low-impact development.

Questions:

1. Has your department conducted research studies on compost or compost amendments?

   Yes

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

   No

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   See: http://www.ciwmb.ca.gov/publications/default.asp?pubid=1248

   I am conducting a related literature review, myself, for CIWMB related to remediation of fire affected soils.

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4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

- Compost enriched bulk hydroseeding
- Compost blanket application following drill seeding X
- Seed application over rough compost blanket
- Seed application over incorporated compost X
- Compost as a general soil amendment
  (e.g. for backfilling around tree plantings)
- Rough compost applied as mulch X
  (composted to remove weed seeds, pathogens, etc.)
- Other
  Please briefly describe application method:

At this point my familiarity is second-hand on all of these. I am planning a study that will address those items above marked with an X

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

See previously mentioned book.

6. Please add any additional comments.

7. If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

Janet Hartin, Bill Baker, Rod Tyler, Britt Faucette, Ron Alexander, Dan Noble. See the speaker lists for our Caltrans workshops:

http://www.dot.ca.gov/hq/LandArch/policy/compost_specs.htm

Thank you for taking time to participate in this survey.

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Interviewee Information:

Point of Contact:	Greg Balzer
Agency/Institution/Employer:	Caltrans
Phone Number:	(916) 653-4337
Email Address:	gregory.balzer@dot.ca.gov

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as a soil amendment.
- The purpose of this review is to illustrate the potential impacts of compost use on water qua vegetation re-establishment, and hydrograph modification. The CalTrans compost specifica may be modified according to the results of this review.
- Goal is to support (or reject) the notion that existing CalTrans specifications for comp application provide downstream and in-situ water quality benefits, boost the viability of vegeta recovery efforts, and support the overall goal of sustainable, low-impact development.

Questions:

1. Has your department conducted research studies on compost or compost amendments?

   Yes

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

   Yes

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   Benefits:
   Increases infiltration, rebuilds long term and medium term nutrient pools, restores soil biology, restores soil structure, increases water holding capacity, provides nutrients for sustainable revegetation.
   Risks:
   Surface and subsurface water quality due to leaching of nutrients and salts.

Please See Second Page

4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

- Compost enriched bulk hydroseeding — Familiar
- Compost blanket application following drill seeding — Familiar
- Seed application over rough compost blanket — Familiar
- Seed application over incorporated compost — Familiar
- Compost as a general soil amendment — Familiar
  (e.g. for backfilling around tree plantings)
- Rough compost applied as mulch — Familiar
  (composted to remove weed seeds, pathogens, etc.)
- Other
  Please briefly describe application method:

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

Best Method
Incorporate 4" of very coarse compost 12-18" deep by ripping or tilling. Hydroseed with seed, fiber and tackafier. Apply 1" of mulch - typically medium weight compost made of composted overs (>3/8").
Risks
Water quality - surface runoff from compost applied as a mulch.

6. Please add any additional comments.

Due to ineffective cost/benefit ratio - Caltrans is probably going to cease applying compost as part of our hydroseeded erosion control treatments.

The new recommended approach to most erosion control situations is to apply a 1" - 2" compost mulch blanket, composed of medium coarseness (>3/8") composted overs. Seed can be applied with the compost, or applied as part of a follow-up hydroseeded application of seed, fiber and tackifier to hold the materials in place.

Where funds allow, and soils are disturbed, it is recommended to incorporate 4" of

If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

Ron Alexander
alexassoc@earthlink.net

Thank you for taking time to participate in this survey.

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Interviewee Information:

Point of Contact:	Kathleen Groody
Agency/Institution/Employer:	Integrated Waste Board/EPA/State of CA
Phone Number:	916-324-6848
Email Address:	kgroody@CIWMB.ca.gov

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as in roadside vegetative recovery applications.
- The purpose of this review is to illustrate the potential impacts of compost use on water quality, vegetation re-establishment, and hydrograph modification. The CalTrans compost specification may be modified according to the results of this review.
- Our goal is to support (or reject) the notion that existing CalTrans specifications for compost application provide downstream and in-situ water quality benefits, boost the viability of vegetative recovery efforts, and promote sustainable, low-impact development.

Questions:

1. Has your department conducted research studies on compost or compost amendments?

   Yes. The research can be found at the CIWMBs web site by searching "compost"

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   Benefits: increased organic matter; slow released nutrients; increased water holding capacity; reduced soil temperatures; inoculation of cut/fill slopes deprived of topsoil with beneficial microbes/Mycorrhizae associated with the desired vegetation; reduced run-off from rainfall; diminished need for irrigation, fertilization.

   Risks: some risks (not established) that compost high in EC may contaminate groundwater, depending on feedstock; some risks (not established) of metals contamination in stormwater runoff from compost, depending on feedstock; some risks

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4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

• Compost enriched bulk hydroseeding	none
• Compost blanket application following drill seeding	some
• Seed application over rough compost blanket	none
• Seed application over incorporated compost	none
• Compost as a general soil amendment (e.g. for backfilling around tree plantings)	use at home
• Rough compost applied as mulch (composted to remove weed seeds, pathogens, etc.)	use at home
• Other	

Please briefly describe application method:

I am less familiar with application methods for large areas, so I cannot contribute much here.

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

6. Please add any additional comments.

As we discussed, I am going to attach a lot of web-based references for your literature review:
1) WSDOT
http://www.wsdot.wa.gov/fasc/EngineeringPublications/Manuals/HighwayRunoff2004.pdf
http://www.wsdot.wa.gov/eesc/design/roadside/
2) Texas
http://trb.org/news/blurb_detail.asp?id=4135
3) EPA
http://www.epa.gov/epaoswer/non-hw/compost/highway/

7. If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

As we discussed this morning, I am interested in considering the application of immature compost (could this be the same product as "rough" compost cited above?). I have learned from Mary Matava (Mary Matava, Agri Service Inc.,760-518-3498 cell, MaryMatava@aol.com) that the use of this material actually more rapidly aggregates poor soils, creating better soil drainage and aeration and facilitating vegetative growth. I recommend you send the survey to her and maybe contact her.

Thank you for taking time to participate in this survey.

CALTRANS DOT Interview Questionnaire

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Interviewee Information:

Point of Contact:	Michael Hogan
Agency/Institution/Employer:	IERS, Inc.
Phone Number:	530-581-4377
Email Address:	mhogan@ierstahoe.com

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as in roadside vegetative recovery applications.
- The purpose of this review is to illustrate the potential impacts of compost use on water quality, vegetation re-establishment, and hydrograph modification. The CalTrans compost specification may be modified according to the results of this review.
- Our goal is to support (or reject) the notion that existing CalTrans specifications for compost application provide downstream and in-situ water quality benefits, boost the viability of vegetative recovery efforts, and promote sustainable, low-impact development.

Questions:

1. Has your department conducted research studies on compost or compost amendments?

   Yes. Extensive.

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

   Yes.

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   Compost blankets post a large risk to water quality. Compost blankets and most revegetation efforts are aimed at growing plants with the idea that plants reduce erosion. Our research has established that infiltration is key. Plants are important but soil edaphic factors are the critical underpinning for erosion reduction. Certain types of compost can help. Screened compost encourages weeds, especially cheatgrass. Compost blankets can pose a significant threat to water quality since they are the lowest density material and thus the first to move in a runoff event.

4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

• Compost enriched bulk hydroseeding	familiar
• Compost blanket application following drill seeding	familiar
• Seed application over rough compost blanket	not familiar
• Seed application over incorporated compost	Very familiar (100's of
• Compost as a general soil amendment (e.g. for backfilling around tree plantings)	Very familar
• Rough compost applied as mulch (composted to remove weed seeds, pathogens, etc.)	don't use
• Other Please briefly describe application method:	Incorporation of compost using

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

Benefits: microbial enhancement=plant growth
Risks: potential for slides, water quality violations, weedy growth,

6. Please add any additional comments.

Text of cover e-mail:
James,

Here is my questionnaire. I hope this is helpful. We have been doing direct rainfall simulator work for several years (see Grismer and Hogan) and have over 1000 plots of data. Still a great many questions, especially about compost blankets.

There is a great potential for Caltrans to find themselves behind the 8 ball with the water boards.

7. If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

Thank you for taking time to participate in this survey.

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CALTRANS DOT Interview Questionnaire

43A0172 - Task Order #51, Compost

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Interviewee Information:

Point of Contact:	Sandy Salisbury, LA
Agency/Institution/Employer:	Washington State Dept. of Transportation
Phone Number:	360-705-7245
Email Address:	salisbs@wsdot.wa.gov

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as in roadside vegetative recovery applications.
- The purpose of this review is to illustrate the potential impacts of compost use on water quality, vegetation re-establishment, and hydrograph modification. The CalTrans compost specification may be modified according to the results of this review.
- Our goal is to support (or reject) the notion that existing CalTrans specifications for compost application provide downstream and in-situ water quality benefits, boost the viability of vegetative recovery efforts, and promote sustainable, low-impact development.

Questions:

1. Has your department conducted research studies on compost or compost amendments?

   yes. http://www.wsdot.wa.gov/Environment/WaterQuality/Research/Reports.htm

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

   yes, Mark Maurer is installing a bioswale with monitoring equipment

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   We have found that good compost enhances plant establishment, especially on roadside subsoils after grading. The risks are in getting good compost, properly applied.

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4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

• Compost enriched bulk hydroseeding	just beginning to get here
• Compost blanket application following drill seeding	have not done that here
• Seed application over rough compost blanket	very familiar
• Seed application over incorporated compost	very familiar
• Compost as a general soil amendment (e.g. for backfilling around tree plantings)	very familiar
• Rough compost applied as mulch (composted to remove weed seeds, pathogens, etc.)	very familiar
• Other	compost vegetated filter strips

Please briefly describe application method:

we've used compost blowers, conveyor belt, and front end loader

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

Risk is good soil-seed contact with compost having a high enough carbon to nitrogen ratio to discourage weeds because WSDOT coarse compost has more wood in it. If we get good/real compost there is not a problem, however if we get poor material delivered and accepted, then we have large failures. Risk associated with construction inspection.

6. Please add any additional comments.

7. If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

James Morin, morinj@wsdot.wa.gov 509-577-1912

Thank you for taking time to participate in this survey.

AECOM

CALTRANS DOT Interview Questionnaire

43A0172 - Task Order #51, Compost

Print Form | Submit by Email

Interviewee Information:

Point of Contact:	Scott McCoy
Agency/Institution/Employer:	KSS Consulting, LLC
Phone Number:	512-288-0499
Email Address:	smccoy26@austin.rr.com

Project Description:

- The California Department of Transportation (CalTrans) is preparing a literature review to support the use of compost as in roadside vegetative recovery applications.
- The purpose of this review is to illustrate the potential impacts of compost use on water quality, vegetation re-establishment, and hydrograph modification. The CalTrans compost specification may be modified according to the results of this review.
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Questions:

1. Has your department conducted research studies on compost or compost amendments?

   Yes

2. Does your department have any future research studies planned that would evaluate treatment benefits to highway runoff from compost and compost amended soil?

   No

3. What risks and/or benefits do you generally associate with the use of compost and compost amended soil for roadside vegetative recovery applications?

   Benefits: Greater plant vigor and sustainability. Reduced runoff and soil erosion. Reduction in stormwater runoff.

   Risks: Some nutrient release can happen depending on type of compost used.

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4. Indicate your familiarity with the following methods of application for compost in roadside vegetative recovery.

- Compost enriched bulk hydroseeding — No
- Compost blanket application following drill seeding — Research, workshops and
- Seed application over rough compost blanket — Research, workshops and
- Seed application over incorporated compost — Research workshops and
- Compost as a general soil amendment (e.g. for backfilling around tree plantings) — Yes
- Rough compost applied as mulch (composted to remove weed seeds, pathogens, etc.) — Yes
- Other — Stormwater applications

Please briefly describe application method:

Blower truck, tractor application with Mill Creek equipment

5. For those methods in question with which you have familiarity, what are the specifically associated risks and/or benefits?

6. Please add any additional comments.

7. If you are aware of other individuals who might contribute a response to this survey, please include their contact information here.

Thank you for taking time to participate in this survey.